

a year, spread throughout the year. How does this fit in with what is known about the New Zealand stoneflies?

First, with the largest group, the gripopterygids, we find a closely related group of genera with a common feature (lack of tibial spurs) not found as such in other gripopterygid groups. Therefore, they must be derived from a single species or group of closely related species. If they arrived 130 million years ago surely there would have been greater differences. This lack of difference could be explained by saying that one species survived the unfavourable conditions until the Upper Miocene when speciation was made possible in more favourable biotopes. If arrival was not by land the most obvious course is by wind drift from Australia from the Upper Miocene onwards. This would account for the close relationship of genera.

The two methods of invasion are also possible for the Antarcoperlinae. However, this subfamily is found only in New Zealand and South America. These two land masses were divided by Antarctica so that it is only possible for them to have arrived via Australia where they must have become extinct at a later time.

The notonemourids can be divided into two groups, the Notonemoura group and the Spaniocerca-Spaniocercoides group. The Notonemoura group has very close relatives in Australia (included in the same genus) and would be a wind drift invader at or after the end of the Pleistocene. The Spaniocerca-Spaniocercoides group consists of forms which differ from their Australian counterparts to a greater degree and are probably pre-Pleistocene.

The remaining two stoneflies *Stenoperla prasina* (Eustheniidae) and *Austroperla cyrene* (Austroperlidae) both have very closely related forms in Australia and are obviously recent invaders by wind drift.

Within New Zealand there is only one endemic found in the North Island but there is considerable endemism in the south with restricted species existing in those areas considered to be Pleistocene refugia. Many of the endemics are found in alpine biotopes. Many of the gripopterygids and antarcoperlinids are wingless and a number of their larvae are terrestrial. The alpine notonemourids have not changed greatly. They have very similar sister species in the lowlands or are forms of lowland species. One point which must be remembered in relation to alpine stoneflies is that New Zealand's alpine biota is not older than Upper Miocene.

#### A PRELIMINARY REPORT OF THE PLECOPTERA FAUNA IN BOSNIA AND HERZEGOVINA (YUGOSLAVIA).

BY DRAGICA KAČANSKI, *Bioloski Institut Univerziteta, Sarajevo, Yugoslavia.*

The faunistical survey of Plecoptera from Bosnia and Herzegovina, which according to ILLIES' classification of the European limnofauna (1967) is situated within the limits of the western Balkan region, is based

TABLE 2. List of Plecoptera species. B = drainage area of the river Bosna. D = drainage area of the river Drina. N = drainage area of the river Neretva (middle reaches). L = running waters in southwestern Bosnia (environments of Livno). O = other localities.

	B	D	N	L	O
<i>Taeniopterygidae</i>					
<i>Brachyptera graeca</i> BERTHELEMY	+	+	+		
<i>helenica</i> AUBERT		+	+		
<i>risi</i> (MORTON)	+	+			+
<i>seticornis</i> (KLAPALEK)	+	+			+
<i>tristis</i> (KLAPALEK)	+	+	+	+	+
<i>Taeniopteryx auberti</i> KIS and SOWA	+				
<i>hubaulti</i> AUBERT					+
<i>schoenemundi</i> (MERTENS)		+			
<i>Nemouridae</i>					
<i>Protonemura auberti</i> ILLIES	+	+		+	+
<i>autumnalis</i> RAUSER	+	+			
<i>hrabei</i> RAUSER	+	+			
<i>intricata</i> RIS	+	+	+		+
<i>praecox</i> (MORTON)	+	+			
<i>Amphinemura standfussi</i> RIS	+	+			+
<i>sulcicollis</i> STEPHENS	+	+			+
<i>triangularis</i> RIS	+	+	+		+
<i>Nemoura avicularis</i> MORTON					+
<i>cambrica</i> (STEPHENS)		+			
<i>cinerea</i> (RETZIUS)	+	+		+	+
<i>dubitans</i> MORTON	+				
<i>flexuosa</i> AUBERT	+	+			
<i>fulviceps</i> KLAPALEK	+	+			
<i>marginata</i> PICTET	+	+			+
<i>minima</i> AUBERT	+				
<i>subtilis</i> KLAPALEK		+			
<i>Nemurella picteti</i> KLAPALEK	+	+			
<i>Leuctridae</i>					
<i>Leuctra albida</i> KEMPNY	+	+			
<i>aptera</i> KACANSKI and ZWICK		+			
<i>bronislavi</i> SOWA	+	+			
<i>cinulata</i> KEMPNY	+	+	+		
<i>digitata</i> KEMPNY	+	+			
<i>fusca</i> (LINNAEUS)	+	+	+		
<i>handlirschi</i> KEMPNY	+	+			
<i>hippopoides</i> KACANSKI and ZWICK	+	+			+
<i>hippopus</i> KEMPNY	+	+			+
<i>hirsuta</i> BOGOESCO and TABACARU	+	+			

TABLE 2. (con't).

	B	D	N	L	O
inermis KEMPNY	+	+			
major BRINCK	+	+			
mortoni KEMPNY	+	+			
nigra (OLIVIER)	+	+			+
olympia AUBERT		+	+		
prima KEMPNY	+	+			
pseudosignifera AUBERT	+	+			
quadrimaculata KIS	+	+			+
rosinae KEMPNY		+			
signifera jahorinensis KACANSKI	+	+			
Capniidae					
Capnia vidua (PICTET)		+			
Capnopsis schilleri (ROSTOCK)	+				
Perlodidae					
Arcynopteryx compacta MACLACHLAN		+			
Besdolus imhoffi (PICTET)					+
Dyctiogenus fontium RIS				+	
Perlodes jurassica AUBERT					+
intricata (PICTET)	+				
microcephala (PICTET)	+	+			+
Isoperla albanica AUBERT	+	+			+
buresi RAUSER	+	+			+
graeca AUBERT	+	+			+
grammatica (PODA)	+				
inermis KACANSKI and ZWICK			+		+
oxylepis (DESPAX)	+	+	+		+
tripartita ILLIES	+	+			
Perlidae					
Dinocras megacephala (KLAPALEK)	+	+	+		
Perla bipunctata PICTET		+			
burmeisteriana CLAASSEN	+	+			+
illiesi BRAASCH and JOOST					+
marginata (PANZER)	+	+	+		+
pallida GUERIN			+		
Chloroperlidae					
Siphonoperla montana (PICTET)	+				+
neglecta (ROSTOCK)	+	+			+
neglecta graeca (AUBERT)		+			
transsylvanica (KIS)	+	+			?+
Chloroperla russevi BRAASCH	+	+			
tripunctata (SCOPOLI)		+	+		+

on material collected since 1958, with the most intensive collecting occurring after 1966.

Adult Plecoptera were collected mostly in the drainages of the Bosna and Drina rivers, in the middle reaches of the Neretva River, in Karst streams of southwestern Bosnia (in the environs of Livno) and from time to time from other localities throughout Bosnia and Herzegovina.

The identification of the collected Plecoptera resulted in 73 species and subspecies (Table 2).

The list of Plecoptera obtained reveals a great variety of zoogeographical elements.

Among the established stoneflies, 3 species (*Leuctra aptera*, *L. hippoides*, *Isoperla inermis*) and a subspecies (*L. signifera jahorinensis*) occur only in the Dinaric ranges.

Five species are found both in the Dinaric ranges and the Carpathian Mountains: *Taeniopteryx auberti*, *Protonemura autumnalis*, *Leuctra bronislavi*, *L. quadrimaculata* and *Siphonoperla transsylvanica*.

Eight species, *Brachyptera graeca*, *B. helenica*, *B. tristis*, *Leuctra olympia*, *Isoperla albanica*, *Perla illiesi*, *Siphonoperla neglecta graeca*, *Chloroperla russevi*, are restricted to the Balkan region. Four species: *Nemoura subtilis*, *Leuctra hirsuta*, *Isoperla buresi* and *I. graeca* occur only in southeastern Europe.

Worthy of note is the finding of 3 species whose center of distribution is the Alps: (*Nemoura minima*, *Dyctiogenus fontium*, *Siphonoperla montana*). The bulk of the remaining species (20) are common to Central Europe.

#### AUTOHEMORRHAGE IN TWO STONEFLIES AND ITS EFFECTIVENESS AS A DEFENSE MECHANISM.

BY ERNEST F. BENFIELD, *Department of Biology, Virginia Polytechnic Institute and State University, Blacksburg, Virginia.*

When subjected to traumatizing stimuli, adults of the stoneflies *Pteronarcys proteus* Newman and *Peltoperla maria* Needham and Smith autohemorrhage at the intersegmental membranes of the coxal and tibiofemoral joints of the legs. Autohemorrhage reactions can be somewhat localized when local stimuli are applied, e.g. if one leg is traumatized, bleeding occurs at that leg. However, a more general stimulus, e.g. grasping the animal's trunk, elicits a response at most or all of the legs.

Autohemorrhage in both stoneflies is an effective defensive mechanism against certain ants. In *Pteronarcys*, autohemorrhage is often of an "explosive" nature in that the hemolymph is forcibly expelled with droplets carrying up to 10 inches from the animal. The "explosive autohemorrhage" of *Pteronarcys* is accompanied by an audible popping sound which, in combination with the hemolymph droplets, was shown to delay attack by a vertebrate predator.